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AN EVALUATION OF TREE MORTALITY IN THE SAYLES SUMMER HOME TRACT, PLACERVILLE RANGER DISTRICT, ELDORADO NTIONAL FOREST

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EXPERIMENT STATION
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ABSTRACT

Red fir mortality was examined in the Sayles Summer Home Tract. Cause of mortality is due to a combination of drought stress, fir engraver beetles, red fir dwarf mistletoe, and annosus root disease. Management alternatives to ameliorate stand conditions are presented.

INTRODUCTION

At the request of Dave Thomas, Silviculturist, Eldorado National Forest, Gregg DeNitto, Susan Frankel and Dennis Hart of Forest Pest Management met on July 7, 1988 with Duane Nelson, David Boyer, and Robin Inhelder of the Placerville Ranger District to examine the Sayles Summer Home Tract. The objectives of the evaluation were to diagnose the cause of increased tree mortality and to provide pest management guidelines for management of the vegetation on the site.

OBSERVATIONS/DIAGNOSIS

Vegetation in the area is predominately red fir, with some lodgepole pine. The stand is comprised of an overstory of 150+ year-old trees with an understory consisting primarily of red fir in small aggregations. The site is a Dunning II. Basal area varies from well-stocked to over-stocked (250-360 sq. ft./ac). Mortality is scattered around a number of permittee cabins, being most severe at the end of the tract adjacent to Sierra Ski Ranch.

Many of the insects commonly associated with old growth red fir were observed. The insects included the fir engraver (Scolytus ventralis) and twig beetles. The fir engraver was associated with branch flagging, top-killing, and tree mortality. Red turpentine beetle (Dendroctonus valens) activity was present in some of the larger lodgepole pine.

Annosus root disease (Heterobasidion annosum) was identified in fir stumps scattered throughout the area. It appeared that this root disease may have been involved in previous windthrow of red fir. Dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae) is infecting much of the red fir. A second species of dwarf mistletoe, A. americanum, is infecting lodgepole pine. Cytospora canker (Cytospora abietis) has infected red fir branches that are supporting dwarf mistletoe infections. This canker fungus was killing some branches, resulting in branch flagging. Nectria canker (Nectria fuckeliana) is also present on the boles of red fir.

PROGNOSIS

Levels of mortality are unusually high. Red fir are predisposed to fir engraver attack by severe drought conditions, overstocking, and dwarf mistletoe. Actual insect attacks and tree mortality occurred last fall, but needles remained green until spring warming caused needle dessication. The existence of overstocked aggregations, dwarf mistletoe, continuing water shortage, and insects will result in increased tree mortality. Red firs will continue to fade through spring of 1989. If normal levels of precipitation do not return in 1988-89, then high levels of tree mortality are expected into at least 1990. The presence of large, dead firs will significantly increase the probability of property damage or personal injury from tree failure.

MANAGEMENT ALTERNATIVES

1. Do Nothing. Tree mortality will continue to occur. Some property damage or personal injury could occur due to tree failure. Red fir dwarf mistletoe will intensify and further reduce vigor of trees. Understory fir will continue to be infected, causing decreased height growth. This, in conjunction with shading, will result in suppressed trees of poor vigor that may never become acceptable replacement trees. Lodgepole pine dwarf mistletoe will also intensify and reduce the vigor of infected trees.

Although stocking levels will be reduced due to mortality, dense aggregates will persist. The resulting stand will be a mixture of openings and dense clusters of suppressed, deformed, and diseased trees. In these aggregations Chronic mortality will occur in these aggregations due to stress brought on by competition for light, space and water. In addition to mortality, top-killing of fir will occur from attacks by fir engraver, especially in larger trees.

2. Salvage Harvest. Identify and remove dead and dying trees. Removal should be done as soon as possible to prevent increased levels of decay resulting in increased hazard to property.

3. Sanitation/Hazard Reduction. A survey would be done to identify dead, dying or defective trees that have the potential to cause damage to property or injury. Also, heavily diseased trees may be removed to improve stand vigor. Through a tree hazard management program, risks to people and property would be reduced to acceptable levels. This would require the removal of many of the trees in the stand.

The removal of many trees over a short period of time could cause several additional problems. Logging damage from felling and skidding could be excessive and lead to future hazards. Residual trees would be exposed to different wind forces and with the lack of adequate root development, could fail. Results from overstory removal activities in true fir indicate that trees in the intermediate crown class often suffer stem breakage following removal of the overstory. Trees with Nectria bole cankers are especially susceptible to this damage.

Activities to reduce the levels of dwarf mistletoe would result in reduced stocking levels which may maintain or increase residual tree vigor. This should lessen the amount of future insect activity.

Following implementation of this alternative, future tree mortality and risk of hazard would be reduced. The residual stand would be understocked with openings common.

4. Vegetation Management. To optimize stand health, a sanitation harvest should be implemented as in alternative 3. This sanitation harvest would be directed at removing dead, dying and hazardous trees, and trees with moderate to severe dwarf mistletoe infections or other defects such as dead tops and large basal scars.

In addition to a sanitation harvest, overstocked aggregations would be thinned. The objective would be to promote a multi-layered stand and to encourage the growth of understory trees for future replacements in the overstory. In much of this tract, dense aggregations will be interspersed among sparsely stocked stands and openings created by the sanitation harvest. The openings created in these thinnings could be replanted with red fir, perhaps with some lodgepole pine mixed in. Because of dwarf mistletoes in overstory red fir and lodgepole it is likely that regeneration will become infected. Adverse effects of these infections may be minimized by efforts aimed at maintaining good rates of growth of the regeneration.

5. Annosus Root Disease Management. The following treatment is appropriate for use in concert with any of the alternatives above. The most effective control for annosus root disease is prevention. The fungus usually becomes established through infection of freshly cut conifer stumps. An application of borax (sodium tetraborate decahydrate, EPA Reg. No. 1624-94) to all conifer stumps immediately after tree felling will prevent most new infections (see FSM 2303.14, R-5 Supp. 164, 9/86). All conifer stumps, even those from dead trees, should be treated as an extra precaution.

6. Relocate Housing Tract. If cabins were removed or relocated, a greater range of management alternatives would be available. More aggressive actions could be taken to speed up rehabilitation of sites and replace existing vegetation with a healthier, more vigorous stand of trees.

PEST BIOLOGIES

FOMES ANNOSUS

Fomes annosus is a fungus that attacks a wide variety of woody plants. All western conifer species are susceptible. Madrone (Artemisia menziesii), and a few brush species (Arctostaphylos spp. and Artemisia tridenta) are occasional hosts. Other hardwood species are apparently not infected. The disease has been reported on all the National Forests in California, with incidence particularly high on true fir in northern California campgrounds. Incidence is somewhat higher in older, larger fir stands and in stands with high basal areas (over about 330 square feet/acre).

During periods favorable to the fungus, fruiting bodies (conks) form in decayed stumps, under the bark of dead trees, or under the duff at the root collar. New infection centers begin by aerial spread of spores produced by the conks and subsequent colonization of freshly cut stump surfaces or wounds on living trees. The fungus then spreads through root contacts into the root systems of adjacent live true fir. Local spread of the fungus from a stump typically results in the formation of a disease center, with dead trees in the center and fading trees on the margin. These centers usually continue to enlarge until they reach natural barriers such as stand openings or non-susceptible plants.

In pines, F. annosus grows through root cambial tissue to the root crown where it girdles and kills the trees. In less resinous species such as true firs, the fungus sometimes kills trees, but more frequently it is confined to the heartwood and inner sapwood of the larger roots where it causes a chronic butt and root decay and growth loss. Thus, while infection in true fir usually does not kill the host, it does affect its growth and thriftiness. Losses in true fir from F. annosus are mainly the result of windthrow resulting from root decay, and reduced root systems which predispose trees to attack and eventual death by the fir engraver beetle. Field observations suggest that vigorous young firs are usually able to regenerate root tissues faster than they are lost to the root disease. But when true firs slow in growth because of stand and/or site conditions, root development decreases to where there is a net loss in roots and the trees slowly decline due to the gradual loss of their root systems. This decline may take 10 to 20 years before tree death occurs.

In general, infections will cross from roots of pine to roots of true fir; however, rarely is the fungus observed to cross from true fir to pine. At higher elevations where pine and true fir are intermixed, F. annosus is commonly found only on true fir and mortality rarely includes both species within an infection center.

RED FIR DWARF MISTLETOE

Red fir dwarf mistletoe, Arceuthobium abietinum f. sp. magnificae, is a seed-bearing plant that parasitizes only red fir. It will not survive without living host tissue, which it depends on for support, food, nutrients, and water.

Dwarf mistletoes initiate their life cycle when a seed lands on a needle or small twig of a host. The seed is coated with viscin, a sticky substance that allows it to adhere to the host tissue. During rains, the viscin becomes mucilaginous, allowing the seed to slide down to the needle base where it may lodge. The seed germinates in the winter or spring and the radicle grows along the twig until it reaches a needle base or bark irregularity. The radicle forms a holdfast and penetrates the twig into the xylem. A type of root system then develops in the twig. In 3 to 5 years from seed deposition, most successful infections will appear as branch swellings and will bear mistletoe shoots. These shoots will not produce fruit until at least 5 years following seed deposition, the average being 8-9 years. Fruit mature in the fall and disseminate seed in September and October. The seeds are explosively discharged from the fruit through the buildup of turgor pressure. Seeds normally have an upward trajectory.

Red fir dwarf mistletoe does not spread rapidly following establishment. Vertical spread in a tree averages less than 3 inches per year. Horizontal spread in a stand without overstory infection is also quite limited. The dense foliage of red fir limits spread because of the high probability of interception of the seed. Spread from infected overstory to understory may be up to about 100 feet, but it is usually less; the actual distance is dependent on slope, wind, and other factors. Trees less than 3 feet tall have a very limited chance of infection because of their small target size.

FIR ENGRAVER

The fir engraver (Scolytus ventralis) attacks both white and red fir in California. Trees ranging in size from large saplings to overmature sawtimber are susceptible. Attacks can cause patch-killing of cambium along the bole, top-kill, or tree death. Top-kill or death occur most often in firs that have been weakened by root disease, dwarf mistletoe, overstocking, soil compaction, sunscald, logging injury, or drought. The fir engraver also breeds in slash and windthrown trees.

The fir engraver usually completes its life cycle in one year, sometimes two. Adults fly and bore into trees or green fir slash from June to September; larvae, pupae, and adults over-winter under the bark. Pitch tubes are not formed as they are with pine bark beetles; the usual evidence of attack is boring dust in bark crevices along the trunk and pitch streamers on the mid and upper bole. Trees colonized early in the summer may begin to fade by early fall, but those colonized later in the year usually do not fade until the following spring or summer, often after the beetles have emerged.